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DATA PROCESSING DIGEST

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UME 2 NUMBER 7 | 914 SOUTH ROBERTSON BOULEVARD • LOS ANGELES 35, CALIFORNIA | JULY, 1956

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General Information

"The 'practical' vs. the 'visionary' approach to electronic data processing"

R. R. Ross, Joseph T. Ryerson & Son, Inc., Chicago
Paper presented at Systems and Procedures Conference, Illinois Institute of Technology, May 1956.

Advantages and disadvantages of the "practical" and the "visionary" approaches are given, and a compromise method is suggested.

The "practical" approach--basically converts punch card routines to electronic data processing equipment in order to speed up reports or simplify card handling routines. Applications are considered and designed as individual procedures, without consideration of possible integration with other systems in the organization.

This approach appeals to management because it 1) offers some immediate tangible benefits, 2) does not involve a large financial risk, 3) provides practical training and experience for programmers and machine accounting operators, 4) acquaints management at all levels with the concept of electronic data processing.

It has some shortcomings which should be considered: 1) It is not broad enough in scope to reach the root of management's problems; 2) it is not geared to long-range company planning; 3) the ultimate goal of electronic data processing is easily lost in the converting of individual applications to the equipment.

The "visionary" approach--considers the relationship among the various "paperwork assembly lines," and integrates these into one data processing system.

This method appeals to top management because it 1) permits "management by exception," and "the speed of the feed-back makes possible a thermostatic type of business control." Also, 2) it considers the advantages of such an approach to the company's competitive position, and 3) it tends

CONTENTS

1 *General Information*
10 *Management Decision-making Techniques*
13 *Systems Design*
14 *Applications, Programming*
16 *Equipment*
17 *Comment*
18 *Training*
19 *Meetings*
20 *References*

Subscription information and the addresses of publishers of digested articles are given on page 20.

to offer relief from the current clerical shortage. "Enlightened management will inevitably come to the conclusion that the move to the 'visionary' approach is no longer a question of 'can we afford to,' but rather, 'can we afford *not* to.' "

The principal objections to the 'visionary' approach are 1) the "major changes required in policy, procedures, and organization, and the fact that these changes might very well place the internal operations of the company in jeopardy"; and 2) the cost of the equipment is very high in comparison with previous equipment. "...It is difficult for a company to visualize an office machine as a *business venture* in the same terms as a factory production machine because no salable product is involved."

Other objections are the impracticability of gradual movement into the system because of the expense of parallel operations, and the fact that the pressure of immediate problems does not allow the time to make the necessary studies.

A compromise approach is suggested in which the company "would adopt the 'visionary' approach and make a complete study of the current data processing routines and develop an electronic data processing system satisfying the management's requirements....on the basis of this projected system, it will be possible to itemize the installation steps necessary to attain the desired goal. Consideration can then be given to the 'practical' approach from the standpoint of an interim step in moving toward an ultimate goal. This consideration should also include an appraisal of the interim equipment to make certain that it is capable of performing the ultimate system which has been developed."

"A Case Study in Planning: Port of New York Authority"

Herbert F. Klingman
Published by Controllership Foundation, January, 1956.

Their experiences can help others foresee difficulties

This very thorough study of the Authority's experience over the past seven years in studying the use of electronics is aptly described in the introductory pages:

"The Port of New York Authority's experiences exemplify fundamental principles, problems, and pitfalls of corporate appraisal of potentialities of electronic data processing and planning for its use. The problems which confronted the Port Authority are those which any business will meet in such research and planning."

The study begins with the Port Authority's early interest in electronics, when its studies were begun in November 1949 by the Comptroller's Department. The results of this early investigation pointed to the toll accounting

operation as being the most fruitful area for establishing electronic methods. A detailed specification for such a system was written, and was of such basic soundness that it is still being used as a standard for equipment selection and design.

The first attempt to acquire the equipment designated by the toll accounting specifications, ended in disappointment when the company chosen was unable to continue under the terms of the original proposal. New proposals from other companies were requested, but none provided the cost savings required, especially in the field and data transmission equipment.

At this point the Port Authority changed the direction of the electronics program. It was decided to put aside, temporarily, the tolls accounting program, and look for electronic equipment for other revenue and cost accounting operations, until advances in the design of equipment suitable for the toll operation had been made. Five flow charts are included in this section, showing the way in which the various accounting operations are being converted to electronics.

A description of the toll operation is included, both in its present aspect, and as it might be handled by automatic electronic methods. This operation is likened to the department store selling operation and the warehousing operation, with the suggestion that similar equipment could be used for these jobs.

Section IV is an interesting account of the selection of personnel for the Electronics Research staff. A description is given of the special tests which were devised, and of the way in which personal interviews were used for final selection of the three persons to be added to the staff. These were selected from Port Authority personnel.

The case study should be of great value to organizations entering the serious study phase, because of its detailed description of the procedures, and the results, both encouraging and discouraging.

((We feel this is an outstanding job of presenting a case study, and the best we've seen in this field.)) Price: $4.00 (for members of the Controllers' Institute: $3.00).

"Guides to inventory policy"

John F. Magee, Arthur D. Little, Inc.
HARVARD BUSINESS REVIEW; Part I, January–February 1956, pages 49–60; Part II, March–April 1956, pages 103–116; Part III, May–June 1956, pages 57–70.

Part I

Techniques for inventory control

There are technical developments which will give "the business manager better control over inventory and scheduling policy." This series of

articles describes these developments for line executives so that they can "make better policy decisions." Many companies have actually used these techniques to clarify policies and to obtain inventory cuts.

"The task of all production planning, scheduling, or control functions ...is typically to balance conflicting objectives such as those of minimum purchase or production cost, minimum inventory investment, minimum storage and distribution cost, and maximum service to customers."

Inventory Functions-- "Fundamentally inventories serve to uncouple ((make independent)) successive operations in the process of making a product and getting it to consumers." In particular there are two classes of inventories:

Movement inventories, or "inventory...needed because of time required to move stocks from one place to another." Part of in-process inventory is "movement stock."

Organization inventories--inventories such that "the more of them management carries between stages in the manufacturing-distribution process, the less coordination is required." The organization inventories are:

1 – Lot size inventories, maintained wherever the user makes a purchase in larger lots than immediately needed, generally to obtain discounts or reduce set-up costs, etc.

2 – Fluctuation stocks, or stocks "held to cushion the shocks arising basically from unpredictable fluctuations in consumer demand" ((called "safety stocks" in Part II of this series, where they are discussed further)).

3 – "Anticipation stocks are needed where goods...are consumed on a predictable but changing pattern through the year, and where it is desirable to absorb some of these changes by building and depleting inventories rather than by changing production rates...." ((The anticipation stocks and their relation to forecasts are discussed in Part III of this series.))

Typical costs influencing inventory policy

The choice of inventory level (or reorder policy) is based on balancing the cost of maintaining the inventory against the savings which result from the independence of organization units.

Inventory Costs-- "the costs that influence inventory policy...are characteristically not those recorded...in directly available form, in the usual industrial accounting system." Although the specific costs required to set inventory policy vary, the following criteria apply:

1 – "The costs shall represent 'out-of-pocket' expenditures, i.e., cash actually paid out or opportunities for profit foregone."

2 – "The costs shall represent only those out-of-pocket expenditures or foregone opportunities for profit whose magnitude is affected by the schedule or plan."

Typical costs are:

"Costs that depend on the amount ordered," e.g., discounts, set-up costs, shipping costs.

Non-routine production costs, e.g., overtime, hiring and training.

Costs of handling and storing, e.g., rent, insurance, obsolescence.

Cost of capital invested (judged in part by the question "what else could we do with the funds, and what could we earn?").

Customer service, or the cost of customer dissatisfaction with backorders and out-of-stock conditions.

Very simple analysis shows that commonly accepted ideas do not always hold. (Two cases are worked out, in which minimum-cost order quantities are calculated.)

Significant Conclusions:

1 – "The appropriate order quantity and the average inventory maintained do not vary directly with sales....One of the sources of inefficiency in many inventory control systems is the rigid adoption of a rule for ordering or carrying inventory equivalent to, say, one month's sales."

2 – "The total cost in the neighborhood of the optimum order quantity is relatively insensitive to moderately small charges in the amount ordered."

(These conclusions are demonstrated by the examples.)

"The only way to cut inventories is to organize operations so that they are tied more closely together. For example, a company can cut its raw materials inventory by buying in smaller quantities closer to needs, but it does so at a cost; this cost results from the increased clerical operations needed to tie the purchasing function more closely to manufacturing and to keep it more fully informed of manufacturing's plans and operations. The right inventory level is reached when the cost of maintaining any additional inventory cushion offsets the saving that the additional inventory earns by permitting the plant to operate in a somewhat less fully organized fashion."

Part II

"Safety stocks are designed to cope with the uncertainties of sales." By use of the proper analytic tools it is possible to establish safety stock levels "to take direct account of uncertainty...characteristics of the systems and...costs."

Two methods of reordering stock

There are two basic methods of reordering stock:

Fixed order, like the classic two-bin system, in which "the same

quantity is always ordered but the *time* an order is placed is allowed to vary with fluctuations in usage." "The key to setting the safety stock is the 'reasonable' maximum usage during the [replenishment] lead time. What is 'reasonable' depends partly, of course, on the nature of short-term fluctuations in the rate of sale. It also depends...on the risk that management is prepared to face in running out of stock."

Periodic reordering, in which the system is "to look at stocks at fixed *time* intervals, and to vary the order *amount* according to the usage." In a typical case "a forecast...of the amount to be used in the future is made for a period equal to the delivery lead time plus one reorder cycle. Then an order is placed to bring the total inventory on hand and on order up to the total of the amount forecast for the delivery lead and cycle times, plus a standard allowance for safety stock." The safety stock then absorbs unpredicted fluctuations in sales. "Many companies subscribe to this plan wholeheartedly in principle, but only halfheartedly in practice. A common tendency, for instance, is to make the forecast but then, if sales increase, to revise it upward and transmit the increase back to the plant. The whole value of a safety stock based on a balancing of the costs of running out and the costs of rush orders to production is thus lost."

The fixed order system is advantageous if: a perpetual inventory is available, unit values are low, sources are flexible.

The periodic reordering system is advantageous where: tighter control is needed, items are ordered jointly, supply source is not flexible.

The interaction between the safety stock, reorder quantity, and reorder level is important.

Setting production levels

Production Scheduling-- Production cycle lengths are related to the cost of safety stocks, setup costs and the cycle stock costs. Production levels must be set to balance costs of changing the production rate and the cost of carrying safety stocks. "...one can 'buy' production flexibility with larger inventories, and vice versa, with the particular costs in the process concerned determining the economical balance." Production capacity, in some cases, must be set to absorb fluctuations in demand.

A detailed example is presented showing how progressively more complex inventory and production control systems can be used to reduce inventory and production costs.

Part III

This part discusses *anticipation stocks*, "commonly needed where sales are highly seasonal." There are two types of seasonal demand: 1) *crash*, for

example in the toy industry before Christmas; and 2) more conventional, with pronounced but longer seasonal swings.

Anticipating seasonal inventory needs

The "crash" problem:

"The question boils down to how much stock to have on hand when the main selling season opens. The objective basically is to have enough on hand so that the company can expect, on the average, to break even on the last unit produced." By knowing how good your sales forecasts are, on the average, and knowing the proper production costs, both pre-season and during the season, and inventory charges, the best anticipation inventory level can be determined. Analytic techniques ((involving calculus)) are used.

"Sometimes from the scanty experience gained in early-season selling enough information can be developed so that estimates of total season sales ...can be adjusted. As more and better information becomes available, mathematical methods can be used to alter the 'strategy' for the season slowly, according to predetermined rules. Such a 'developing' approach to inventory problems rests on the basic premises that one does not know the future, that there is therefore no need to plan into it very far in great detail, and that a good strategy for the present is one which puts you in a position to make a good choice the next time you have a chance...."

Seasonal swings:

Three problems arise:

1 – Allowing the proper safety stocks for forecast errors.

2 – Laying out a minimum-cost production plan.

3 – Controlling production in line with actual sales.

"...safety stocks must be large enough so that stocks can be restored after a sudden unexpected sales spurt by a smooth and moderate adjustment in production rate."

Graphical and analytic techniques are available to develop minimum-cost production plans. Linear programming is used in complex situations. "...The objective is to minimize the total of costs....The objective has to be reached within the limitations imposed by: a) capacity restrictions... b) the requirement that inventories in each line...be...large enough to meet sales requirements; and, possibly, c) the amount of variation that can be tolerated in the planned production rate."

Production is controlled by periodically correcting production by some fraction of the total adjustment required; the fraction calculated to minimize inventory costs and production change costs.

Important sales and production characteristics which "strongly influence the production and inventory control system" are:

Sales characteristics--1) the unit of sales (dozens, tons, or carloads), 2) the

size and frequency of orders; 3) uniformity or predictability of sales (predictable seasonal fluctuations or large short-term fluctuations); 4) service requirements or allowable delay in filling orders; 5) the distribution pattern (do shipments go direct from factory to customer, through warehouses, retailers, etc.?); 6) the accuracy, frequency, and detail of sales forecasts.

Production characteristics--1) the form of production organization (job shop or production line); 2) the number of manufacturing stages; 3) the degree of specialization of the product at specific stages (is each end product distinct from the raw material stage on, or are the different products more or less the same up to the final processing?); 4) physically required processing times at each stage; 5) capacity of production and warehousing stages; 6) production flexibility (how rapidly can management vary production rates, shift personnel among product lines or departments, and change equipment from one product to another?); 7) kind of processing (are batches of materials of a certain size needed?); 8) quality requirements, shelf-life limits, or obsolescence risks.

Estimates of future sales

"The need for estimates of future sales to control inventories is clearest in the case of anticipation stocks....The question is whether the necessary forecasts are being made as well as they might be if formally recognized and if available statistical and market research techniques were used.

"Economical inventory plans depend on realistic estimates of need.... there are bound to be forecasting errors--and the bigger the possible errors, the bigger the inventories must be to guard against them. A single forecast figure, without specifying the estimated error or limits of error, is not enough ....to estimate the limits of error requires a comparison of past forecasts and sales...."

As for production scheduling, "almost all products and product lines are capable of being manufactured under a wide range of organizational forms intermediate to the extremes of either pure job-shop or assembly-line operation." In one example, "although demand for individual end products was unpredictable, demand translated into component requirements showed considerable stability."

"A comprehensive inventory control system should be closely coordinated with other planning and control activities, such as sales forecasting, cash planning, and capital budgeting..." The control system involves three basic planning features:

1 – "The *long-range* plan makes use of a) sales forecasts...and b) preliminary policy decisions on capital allocation...and on the amount of risk to be assumed. The purpose is to show the implications of policy choices...and then to provide a basis for long-range operating decisions....

2 – "At the intermediate stage, the *short-range* plan uses as its...inputs: a) the results of policy decisions, b) short-term demand forecasts, c) existing facilities and manpower, and d) inventories. The outputs are...the general production plan to follow, adjustments in the employment rate, corrections in inventory balances.

3 – "Finally, within this framework *scheduling* can react to demand as it actually materializes.

"The indicated steps may be taken unconsciously or by hunch; or they may be part of...a carefully organized program, with calculations done by hand or on a high-speed computer."

Final comments: "...the appropriate inventory balances are determined by a variety of cost or value elements. However, the essential costs are characteristically not the costs reported in summary accounting records. The cost information needed often requires reorganization or restatement of the accounting costs to arrive at definitions suited to the specific problem at hand.

"...the same basic criterion governs investment in inventories as in other capital assets: What is the best balance between added earnings, cost savings, and intangible benefits, on the one hand, and investment and maintenance costs, on the other?....Inventory functions are more complex, the advantages more subtle, and the balance of gains and costs much more difficult to find [than in other capital decisions]. It is perhaps as a direct result that inventory decisions have been based more on intuition than on logic and arithmetic. This has led to trouble. Intuition-based policies are not always easy to administer or to keep up to date—or to keep track of."

((Example cases are given throughout the series to illustrate points made.))

Automatic Data Processing Service

John Diebold & Associates, Inc.
Published by Cudahy Publishing Company

Confidential information service

This reporting service on automatic data processing includes periodic bound reports on equipment, methods, policy, orientation materials, special reports, and a bi-weekly newsletter. Equipment reports cover equipment in the following classes: system input, communication, conversion, processing, and system output. Policy reports cover the entire range of subjects related to investigating electronics, making feasibility studies, preparing for a computer, training, etc. Binders are provided to hold the reports and the newsletters. Cost of the service for one year: $480.00.

"Proceedings"

Eastern Joint Computer Conference, November 1955, Boston, Mass.

Technical aspects of business computers

The eighteen papers presented at the Eastern Joint Computer Conference are published along with the discussion periods which followed some of the papers. Emphasis of the conference was on technical and engineering aspects of computers in business applications. Copies may be purchased from any of the sponsoring societies at $3.00 per copy: Institute of Radio Engineers, Association for Computing Machinery, American Institute of Electrical Engineers.

Management Decision-making Techniques

"Multiple factor break-even analyses: The application of operations research techniques to a basic problem of management planning and control"

Robert S. Weinberg, M.I.T., Cambridge, Mass.

OPERATIONS RESEARCH, The Journal of ORSA; April 1956, pages 152–186.

Significant article on business analysis techniques

((We feel that this article is a milestone in the development of business economics and top-management planning methods. There has been dissatisfaction among businessmen with "classical" economics, because of its failure to take into account the effects of advertising and competition, especially where there are a few major producers in an industry, and to relate the status of the general economy to the prospects of a particular firm. The work described in this article directly attacks these problems, and may well form the basis for important changes in the methods of analyzing business situations. The article is recommended to all who seriously study top-management decision-making methods.))

"To date published operations-research studies have dealt exclusively with a wide range of specific and somewhat narrow business problems. Such specific operating problems as inventory control, production scheduling, quality control, market analysis, the allocation of specific effort (advertising, etc.). The present paper will discuss the application of operations-research techniques to a more general and higher-order (organizationally) class of business problems. It will be demonstrated that operations-research techniques may be successfully applied to a wide range of aggregate top-level problems of business planning and control....The planning situations described [in this article] are those generally proposed at the board of directors, finance committee, or operating vice-president level. Selecting operating profits as the primary measure of effectiveness, it [will] be shown that a company's profits are dependent upon four basic factors: the level of general economic activity, the level of total industry sales, the company's competitive strategy and the counter strategies of their competitors, and the company's policy toward and control over their own cost structure."

Intra–company relationships

The article describes how a hypothetical ((but realistic)) company is analyzed. Three basic relationships are established.

1. The E–I Relation: The relationship between the general economic condition (E) (measured by Disposable Personal Income) and the probable total sales (I) in the particular industry of which the company is a part.

2. The I–C Relation: The relationship between the total industry sales (I) and the company's net sales (C or S). This relationship includes the effect of "exchanges" (of sales volume) between the company and its competitors. The effect of market "expansionary expenditures" is included in the "exchanges."

3. The S–P Relation: The relation between the company's net sales (S or C) and its profits (P). The effect of cost-increasing factors (e.g., depreciation on new equipment for a new product) are included in the relationship.

From an analysis of government and company data, these relationships are expressed quantitatively.

As a result of these relationships (which are called the "model") it is evident that a company can increase profits in three ways:

"1. By changing the product line it may elect to operate within a new industry and thereby change to the E–I relation applicable to its operation;

2. By capturing a greater share of the market, thus improving its I–C relation;

3. By controlling its cost structure, thus improving its S–P relation.

"To accomplish the first two courses of action the company will generally have to incur additional expenditures, which will weaken its S–P relation. An exception would be the special case where the company finances these actions by curtailing other, less profitable expenditures. While this represents the ideal case, the company shifting its operations from unprofitable or less profitable to more profitable activities, it is seldom completely attained. The company's strategy therefore must center upon the interrelation between its I–C and S–P relations and the feedbacks between its expansionary outlays and the share of the market it may penetrate."

All three of these relations change each year. This analysis makes it possible to separate increases (decreases) in profits into basic causes:

Reduced costs (improved S–P relation)

Larger share of the market (improved I–C relation)

Better business conditions (improvement in E)

Entering new market (improved E–I relation), etc.

The analysis can be used to study long-range strategies; for example, the result of a merger with various other companies.

The method offers the following advantages:

Available data used for top level policy–making

"1. It offers a framework for research on the operations of the whole organization: internally, within the industry, and within the economy.

2. The model renders explicit all the factors that determine both the short- and long-term profitableness of the enterprise, and it allows the analyst to develop quantitative measures of the profit productivity of various courses of executive action; this facilitates the optimization of profit expectancy.

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3. The model represents a synthesis and extension of techniques currently in wide use....The required input data are often already available, and the results of the analysis are presented in terms with which business executives are already familiar.

4. The treatment of competitive 'exchanges'...gives an insight into the behavior of the actual operation (the competitive structure)...

5. The use of an integrated multi-disciplinary research team was followed ...most of the cases studied were initiated for the office of the president, the board of directors, or the company finance committee; the input data, and often the basic parameters of the model, represented the combined efforts of the company, marketing, manufacturing, engineering, comptroller, legal, public relations, and employee relations personnel....

6. The model was formulated and the parameters estimated in a manner common to the basic sciences making use of the newest scientific methods and techniques.

7. Once the model is formulated and its parameters derived, given estimates of the independent variables, the analyst may derive quantitative measures of the associated profit expectancies which offer a direct basis for management action; the model is not merely descriptive but offers an objective and quantitative evaluation of the impact of the factors under consideration on the firm's profits, and therefore, is useful in making future policy decisions.

"As corporate organizational structures become more complicated, the business communication problem becomes more difficult; and as data collection and record keeping becomes more precise and departmentalized, it has become far more difficult for a member of any one internal organization unit to obtain data, comparable to his own, describing the operations of the other internal units....As the organizational structure becomes more formal, too few executives within the company have either the time or the authority to consider such over-all concepts as the company's total cost structure, its S–P relation, or its general economic activity profits complex.

"Those few top-level finance and comptroller executives who may have access to these over-all data often are unfamiliar with the actual operation of the units whose data they are analyzing....When data are submitted individually by the various operating departments, these data are quite often uncomparable, contradictory, and inconsistent.

"A top-level, over-all, company- policy operations-research group can eliminate most, if not all of these difficulties. Given free access to the required operation data and the authority to cross the formal communication lines, such a group can develop over-all planning models of the type discussed above.... As this age of specialists and detailed specific departmental responsibility progresses, the need for an over-all, operations-research type, planning and coordination group becomes more and more acute."

((See Comment section, page 17.))

Systems Design

"An electronic accounting system"

R. R. Ross, Joseph T. Ryerson & Son, Inc., Chicago
*Paper presented at Systems and Procedures Conference, Detroit, October, 1955.**

Data processing requirements of entire company are integrated

A master plan for an electronic accounting system is suggested, to illustrate the integration of basic accounting functions. The illustration is for a retail or wholesale business. Five basic runs comprise the system: Inventory Accounting**, Customer Accounting, Vendor Accounting, Employee Accounting, General Accounting.

"The runs were developed only after a full consideration of the interrelationship of functions and the most effective machine utilization." Each of the runs is described in detail and illustrated with a flow chart. The interrelation of the functions shows up on the flow charts. For example, the Inventory Accounting operation produces the daily sales report and the purchase requisitions, both of which are used as inputs in the Vendor Accounting operation. The account distribution tapes for each run are summarized in the general ledger tape in the General Accounting run. The Employee Accounting run includes not only the payroll operation, but complete personnel records, from which personnel statistics, such as accumulated earnings and government reports can be derived. In each run, all input records are previously arranged in numerical order appropriate to the particular run: for example, product number sequence in the Inventory run. Changes in names and addresses, or additions to product line, etc., are prepared on punch cards which are used as inputs to correct the affected tape. Checks are automatically prepared on punch cards.

Although electronic data processing is usually considered as the solution for large volume jobs, once a company has installed the equipment "greater emphasis will be placed upon the equipment as a tool for scientific management and as such the facts must be gathered from all phases of a business, thus the need for *integrated electronic processing*."

*Published in *Workshop for Management* (Management Publishing Company—see DPD June, 1956, page 8.)

**In a manufacturing business, this would become a Production Control run and the Account Distribution Tapes would be altered.

"Processing business data"

Charles W. Adams, Creole Petroleum Co., Caracas, Venezuela
CONTROL ENGINEERING, June 1956; pages 105–112.

Control system concept

Business data processing is described as a kind of control system, using people rather than devices. The problems in choosing between random access and tape files, the requirements for sorting and computing, and detailed descriptions of inventory and payroll data processing are given in a manner which would make business data processing meaningful to control engineers.

Applications, Programming

"Electronic programming"

J. W. Balet, Consolidated Edison Company, New York
AMERICAN GAS ASSOC. MONTHLY, February 1956, pages 23, 24, 40, 41

Preparing a payroll operation for a computer

Five steps are given which Consolidated Edison followed in programming their payroll process, the first operation chosen by the company to be done by their IBM 705.

Step 1. The Balloon Chart. "The balloon chart is the starting point of programming and is the simplest representation of a computer operation. It merely outlines the number of tape units that must be connected to the computer and presents a general picture of what information is to be processed."

Step 2. The Master File. "The master file contains the basic information necessary for the payroll operation....This information is spread along a magnetic tape in serial form...The design of the master file is further complicated by the fact that the exact location on the tape of each piece of information, down to the last character, must be known and completely described by the program."

Step 3. The Flow Chart. "...A system design for the particular accounting procedure which is generally outlined by the balloon chart must be reduced to three basic operations of the computer: 1) arithmetic computation; 2) movement of information within the computer system; and 3) the making of comparisons.... Every last detail of the accounting procedure must be pin-pointed and provided for. ...since the computer has no independent judgment and will not even indicate when a step is missing."

Step 4. Coding. "The writing of the individual instructions from the flow chart and the operations outlined by the chart must be fully described by the individual instructions to the computer."

Step 5. The Print-out. "The invisible information on the tape must be translated onto a printed page, either for permanence or to provide the means of ready reference to the information."

ConEdison's conclusions about programming are:

1. Good programming is essential to the application of a computer.
2. Programming an accounting procedure is a long and arduous task.
3. There are no short cuts and no immediate prospects of short cuts through automatic programming.

4. The programming of one company cannot be directly used by another company.

5. Because of these conditions, programming may be a serious limitation in widespread use of computers by utilities.

"Automation comes to purchasing"

PURCHASING, April 1956; pages 99, 100

Inventory on tapes

IBM uses its own equipment in automatic processing of purchasing operations. At Poughkeepsie the 702 is used to indicate changes in inventory status and need for buying or expediting, by keeping up to date a series of tapes showing the changes in stock levels. Cards are punched to indicate the various needs: need for expediting--passed to production control; need for a buy--sent to planning.

It is possible to go a step further, using a secondary tape to cause a printer to prepare purchase orders. The Cardatype will be used at IBM's Kingston plant for semi-automatic order writing.

"Automated buying methods"

PURCHASING, May 1956; pages 56-58.

Pre-punched stock cards

Northrop Aircraft, Inc. mechanized buying procedures by using tabulating and calculating machines. Stock cards are pre-punched with standard information about stock items, other cards carry vendor information. A third card is punched with order information from the purchasing agent. A single summary card is punched from the information on these three. Then a purchasing order is prepared from this card.

Follow-ups and perpetual inventory are easily done using the information from the punched cards.

"Business Data Processing -- A Review"
REPRINTS AVAILABLE
$1.00 ea.

A four-part series of articles on the patterns of business data processing which appeared in June, July, August, October, and December, 1955 issues of DATA PROCESSING DIGEST. To order, write Canning, Sisson and Associates, 914 South Robertson Blvd., Los Angeles 35, Calif.

Equipment

MTM Transrecorder

Remington Rand Univac

Tape data by telephone channels

The Univac MTM Transrecorder is a device for reading data from magnetic tape, transmitting the data via telephone channels, and recording it again on magnetic tape. The Transrecorder is expected to be available early next year. Although the tape units in the Transrecorder will operate at rates above 20,000 bits per second, actual transmission speed will be limited by characteristics of the transmission line. The first models will transmit at 100 characters per second on any commercial 3000 cycle telephone channel. The transmission rate will be increased as quickly as the development of terminal equipment and telephone transmission circuits will permit.

Addressograph–Multigraph and Eastman Kodak Electronic Data Processing System

High–volume mailing

These two companies have introduced a new system to be manufactured by Eastman Kodak and distributed by Addressograph–Multigraph. The system was designed especially to handle large volume mailing list operations. The equipment consists of a Magnetic–Tape–Operated Electronic Printer capable of printing speeds up to 3000 lines per minute, a Punched–Card–to–Magnetic Tape Converter with a card–feeding speed of 600 per minute, and a selective Magnetic Tape Recording System which can record data from punched card onto from two to ten separate tapes.

"Electrofax dry-photographic enlarger"

JOURNAL of the Franklin Institute, May 1956; pages 584, 585.

Microfilm printer

The Electrofax, developed by RCA can reproduce fifteen standard-size engineering drawings per minute from microfilm originals. The printer is designed for use with the Filmsort system, which files and selects drawings mounted on separate electric accounting machine cards. The Electrofax can also process 35-mm. roll microfilm.

Comment

Why O. R.?

Ready–made solutions for business problems?

Often when faced with setting a key policy in a complex situation, one longs for a "cook-book" which will give a recipe to solve the particular situation. Business decisions seem to be complex in that they involve many interrelated and hard-to-measure factors. Most policy-makers (executives) realize that analytic or operations research techniques can help them understand the situation better, isolate the factors and aid in selecting the most profitable policies.

But making an O.R. study is expensive and time-consuming. And after all, it appears that many businesses have similar characteristics. Would it not be possible to develop a "policy book" (the "cook-book") to tell us what to do in each case?

The three-part article "Guides to Inventory Policy," digested on pages 3–9 contains a clue as to why such a cookbook is not possible. On pages 7, 8 fourteen sales and production characteristics are listed. Let us assume, conservatively, that each characteristic can have three levels. For example, we might classify "unit of sales" as single items, small packages, carloads. We might classify "service requirements or allowable delay in filling orders" into short (hours), medium (days), long (months). "The form of production organization" might have these levels: job-shop, mixed, assembly line (or continuous process). Using only three levels is obviously a simplification; but even so the results are revealing. Since there are 14 characteristics of three levels each, there are at least 3^{14} or (approximately) 4,800,000 different kinds of business possible. Thus our "cookbook" would be very large. It is easy to see, then, that no one could afford to write such a book, and we will have to resign ourselves to writing our own recipes; that is, to solving each policy decision with a study of the specific case.

The design of a data processing system and the selection of equipment for it is usually a key decision in a company. Yet since each business has different characteristics, it cannot use, at least in detail, the results of a study performed in another plant (or even in another division of the same company). What we can learn from the studies and experience of others is how to make our study faster and better; and we can learn of pitfalls to avoid.

Seat-of-the-pants decision-making is no longer sufficient in today's complex world; and cookbooks are not available. So, as the physical scientists found out some time ago in their own fields, we must resort to scientific analysis—to O.R.—a form of *organized ruminating* sometimes called operations research!

Training

July 30–August 3, 1956 **Hamilton, New York**	Workshop Seminar #613--"Installing and Administering Electronic Data Processing Systems," American Management Association Summer Office Management Program; Colgate University. For information write to Seminar Registrar, A.M.A., 1515 Broadway, Times Square, New York 36, N. Y.
July–August 1956 **Cambridge, Mass.**	Special Summer Program at Massachusetts Institute of Technology includes the following: July 30–August 11, Control Systems Engineering; August 6–11, Electronic Computers and Business Problems; August 13–18, Analog–Digital Conversion Techniques; August 13–18, Business Management and Electronic Data–Processing. For further information write: Office of the Summer Session, Room 7–103, M.I.T., Cambridge 39, Mass.
July 23–August 11 **Detroit, Mich.**	Wayne University computation Laboratory, Summer Program: July 23–28, "Automatic Computers--Their Application and Evaluation." July 30–August 4, "Electronic Data Processing in Business and Government." August 6–11, "Applications of Computers to Engineering, Science, and Industry." For information write to: A. W. Jacobson, Director, Computation Laboratory, Wayne University, Detroit 1, Mich.
July 25–29, 1956 **Ashome Hill, England**	Production Engineering Summer School. For information, write The Institution of Production Engineers, 10 Chesterfield Street, London, W. 1, England.
September 1956 **Dayton, Ohio**	Office Automation, evening classes at University of Dayton, tentatively set for September. For further information write: Mr. Arthur L. Holt, University of Dayton, Dayton 9, Ohio.
September–June, 1956–57 **Pittsburgh, Pa.**	Electronic Data Processing Courses: Data Processing Principles and Methods, Data Processing Laboratory, Business Applications of Data Processing Equipment, Laboratory in Business Applications of Data Processing Equipment, Managerial Aspects of Electronic Data Processing, Individual Research on Data Processing Applications. For information write to Bureau of Business Research, University of Pittsburgh, Pittsburgh 13, Pa.
September 4–7, 1956 **Denver, Colo.**	Special advanced course in computer techniques, by Dr. John W. Carr of U. of Michigan. For information write to William B. Kennedy, The Denver Research Institute, University of Denver, Denver 10, Colo.
October 29–November 2, 1956 – Cleveland, Ohio	Special Seminar Program, Western Reserve University, School of Library Science: Machine Literature Searching, Operations Research Approach, Theory of Classification. For information write to Jesse H. Shera, Dean, School of Library Science, Western Reserve University, Cleveland 6, Ohio.
February 4–8, 1957 **Cleveland, Ohio**	Special Seminar Program, Western Reserve University, School of Library Science: Documentation Survey, Machine Aids to Librarianship, Special Libraries. For information, write as above.

May 20–24, 1957 Cleveland, Ohio	Special Seminar Program, Western Reserve University, School of Library Science: Machine Literature Searching, Special Libraries, Report Writing. For information, write as above.
Summer 1957 Cleveland, Ohio	Special Seminar Program, Western Reserve University, School of Library Science: all of above courses in intensive two-week course. No dates set. For information, write as above.

Meetings

August 21–24, 1956 Los Angeles, California	WESCON Convention – includes a session on Computers—Data Gathering and Presentation Systems. For information write WESCON, 344 North La Brea, Los Angeles 36, Calif.
August 27–29, 1956 Los Angeles, Calif.	Annual Meeting, Association for Computing Machinery, U.C.L.A. For further information write: Association for Computing Machinery, 10749 Sarah St., North Hollywood, Calif.
September 30– October 3, 1956 New York	National Conference, Controller's Institute, Waldorf–Astoria.
October 18, 19, 1956 Los Angeles, California	Meeting of The Institute of Management Sciences, Statler Hotel.
October 22–24, 1956 Philadelphia, Pa.	International Systems Meeting, Annual Convention of the Systems and Procedures Association of America, Bellevue–Stratford Hotel. For information write to J. A. MacQueen, Alan Wood Steel Co., Conshohocken, Pa.
November 8, 9, 1956 San Francisco, Calif.	N.M.A.A. Second Annual Electronic Business Systems Conference, sponsored by the eleven Western N.M.A.A. Chapters; Sheraton–Palace Hotel. For information, write to P. O. Box 3584 Rincon Annex, San Francisco, Calif.
November 15, 16, 1956 San Francisco, Calif.	Meeting of Operations Research Society of America, tentatively scheduled for these dates. For further information, write T. E. Oberbeck, Naval Post Graduate School, Monterey, California.
November 26–30, 1956 New York City	Third International Automation Exposition and Computer Clinic. Trade Show Building. For information, write International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.
December 10–12, 1956 New York City	Eastern Joint Computer Conference, Hotel New Yorker.
February 26–28, 1957 Los Angeles, California	Western Joint Computer Conference, Statler Hotel. Theme: "Techniques for Reliability."

References

The addresses of publishers and periodicals mentioned in this issue of Data Processing Digest are listed below for your convenience in obtaining further information about the articles or books listed.

American Gas Association Monthly
420 Lexington Ave.
New York 17, N. Y.

Control Engineering
330 West 42nd St.
New York 36, N. Y.

Controllership Foundation, Inc.
Two Park Ave.
New York 16, N. Y.

Cudahy Publishing Co.
6141 North Cicero Ave.
Chicago 30, Ill.

Harvard Business Review
Soldiers Field Station
Boston 63, Mass.

Journal of the Franklin Institute
20th and the Parkway
Philadelphia 3, Pa.

Management Publishing Corp.
22 West Putnam Ave.
Greenwich, Conn.

Operations Research: Journal of ORSA
Moun' Royal & Guilford Ave.
Baltimore 2, Md.

Purchasing
205 East 42nd St.
New York 17, N. Y.

See DPD April 1956 for list of more than seventy periodicals regularly reviewed for significant information in the data processing and related fields.

DATA PROCESSING DIGEST is published each month by Canning, Sisson and Associates, 914 South Robertson Boulevard, Los Angeles 35, California. Subscription rate: $24.00 per year. Foreign postage (exclusive of Canada and Mexico): $1.00 additional. Single copies: $3.00 when available. Editor: Margaret Milligan.